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Wrap-Up Report of 2016 Workshop on Bio-Ethanol and Climate Change

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Biofuels

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Report Highlights:

With climate change and air pollution at the forefront of environmental concerns, Bioethanol is a proposed solution in addressing these issues. At the Bioethanol and Climate Change Workshop, integrating the fuel is suggested as an affordable and reliable option to mitigate GHG (greenhouse gas) emissions. This report includes guest speakers' remarks on the economic and political background, as well as how countries like South Korea can implement Bioethanol into the fuel economy. The ethanol industry has shown success in the U.S. and Brazil with the capacity to expand globally, as the benefits to both producers and consumers are important to understand for future implementation.

General Information:

2016 Bioethanol & Climate Change Workshop

Below, L to R: DUS Jonathan Cordone discusses the benefits of adopting Bioethanol as a supplement to Korea's energy policy with KREI¹ president, Mr. Chang-Gil Kim and USGC Korea director Mr. Haksoo Kim



Source: Young Dong Han, Agricultural Trade Office Marketing Clerk

Note¹: Korea Rural Economic Institute (KREI)

Summary:

2016 Bioethanol & Climate Change Workshop

With climate change and air pollution at the forefront of environmental concerns, Bioethanol is a proposed solution in addressing these issues. At the Bioethanol and Climate Change Workshop, integrating the fuel is suggested as an affordable and reliable option to mitigate GHG (greenhouse gas) emissions. This report includes guest speakers' remarks on the economic and political background, as well as how countries like South Korea can implement Bioethanol into the fuel economy. The ethanol industry has shown success in the U.S. and Brazil with the capacity to expand globally, as the benefits to both producers and consumers are important to understand for future implementation.

The Seoul Office of Agricultural Affairs and United States Grain Council conducted the Bioethanol Workshop on June 9th, 2016, highlighting potential benefits and affordability of blending ethanol with gasoline. The USDA Deputy Under Secretary (DUS) Jonathan Cordone set the tone for the forum with remarks regarding how beneficial the Renewable Fuels Standard (RFS) has been for the United States. As a result, GHG emissions have decreased and progress has been made in decreasing air pollution. The intention is to make Bioethanol a global industry, as increased U.S. exports assist with the fuel's development into the global economy. Although enforcement of renewable fuels' policies is weak in certain countries and infrastructure constraints exist, continued education on benefits should expand the market. Countries at the Paris Climate Change Conference

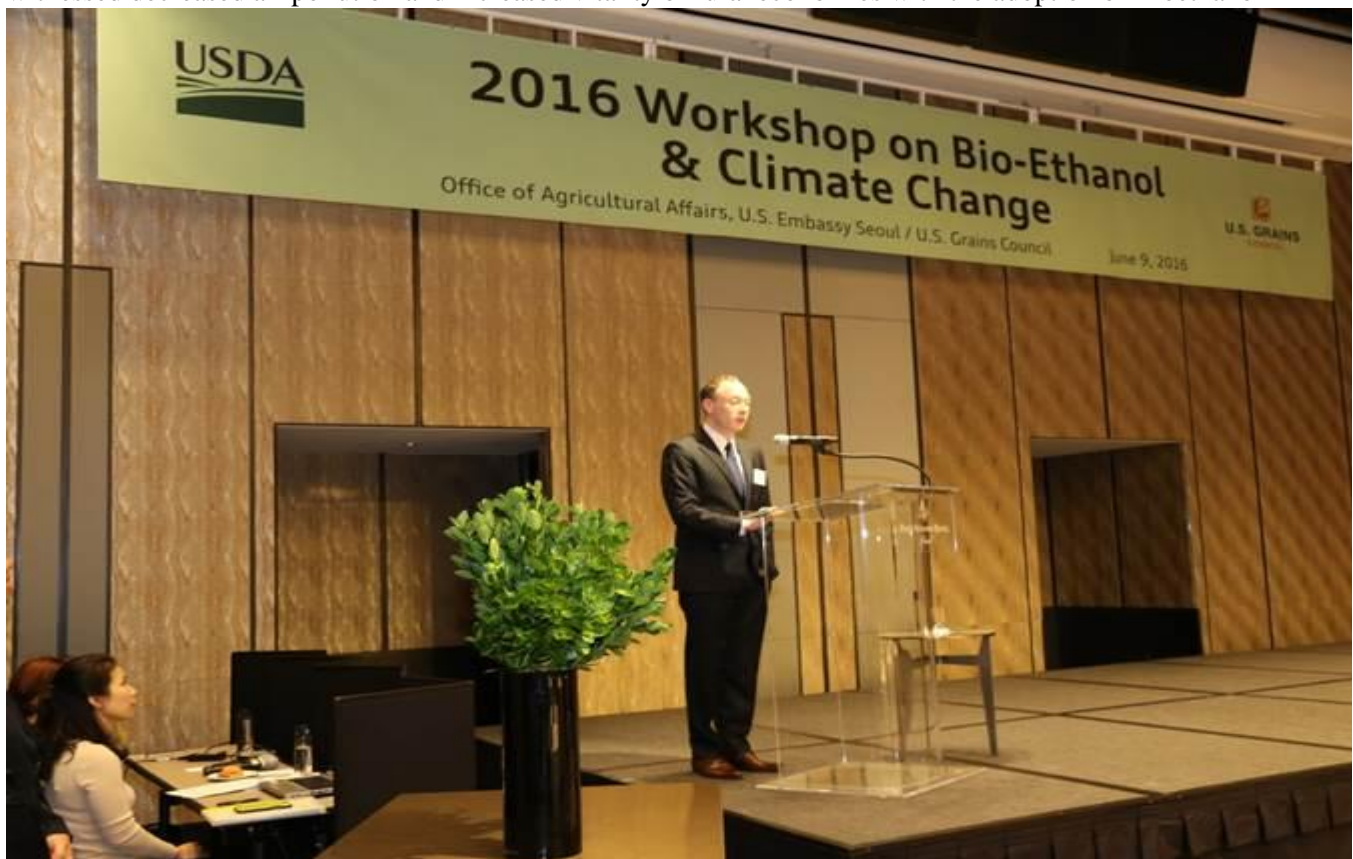
promised to mitigate GHG emissions by proposing specific goals in reduction, and the use of ethanol is one strategy to help accomplish those targets.

Opening Remarks

Presented by: Jonathan Cordone

Integrating Bioethanol within the U.S. economy is important in creating jobs, mitigating emissions, and addressing climate change. It is suggested that Korea may witness the benefits of incorporating the fuel by establishing mandates to blend with gasoline. The U.S. has had a successful framework for integration with the RFS of E10 representing this initiative. The fuel benefited producers through increased employment and has served as an affordable option for consumers, as the current mandate of E10 has been safe and effective with modern technology. By blending with gasoline and implementing mandates, the U.S. is a leader in production and continues to improve the vitality of rural economies.

Below: DUS Cordone opens Bioethanol & Climate Change Workshop by discussing the U.S. experience that has witnessed decreased air pollution and increased vitality of rural economies with the adoption of Bioethanol

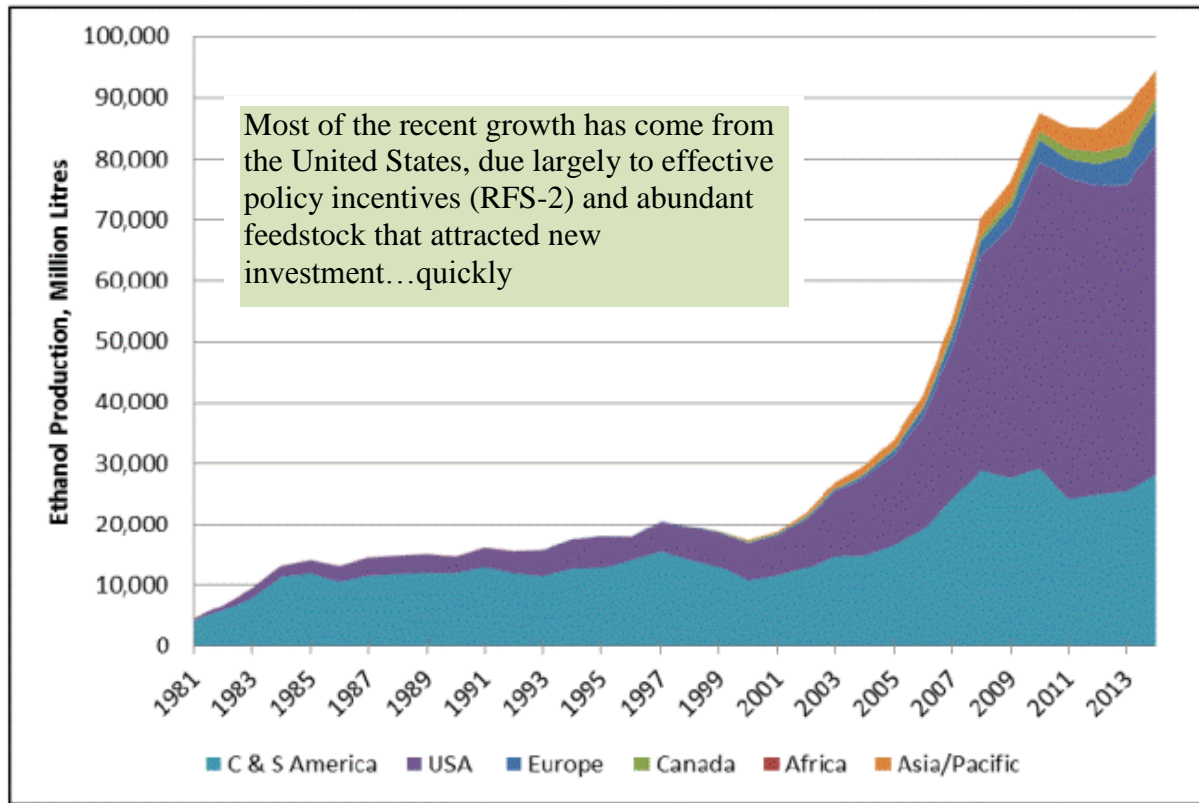


Source: Young Dong Han, Agricultural Trade Office Marketing Clerk

Presentation #1: "Global Ethanol Overview"

Presented By: Michael Dwyer, Chief Economist, U.S. Grains Council

Figure 1. Global Ethanol Production (1981 – 2014)



The intention is not to build just a local but global Bioethanol industry, as the U.S. and Brazil are currently the leading producers in the world. The U.S. utilizes corn for the majority of its production and Brazil processes sugarcane. Though the global arena has sought to implement greater use of biofuels with policy, enforcement has not always been successful. Problems with global execution include infrastructure constraints in the background of volatile prices in the oil market.

Bioethanol has taken the lead in the fuels market in terms of growth, while Asia is the fastest growing fuels market in the world that is driven by a rising middle class. Countries within this region must educate themselves about Bioethanol's benefits, especially when China and India continue to have issues with the management of air pollution. In terms of commodities, trade in Bioethanol is noticeably low and margins in the U.S. are tightening. This implies it is ever more prudent to open global markets within Asia, as this region is characterized as having some of the lowest usage rates. Chinese imports from the U.S. are trending up, as China has become the largest U.S. export market.

Organizations such as FAS and USGC strive to educate policy makers. Both the U.S. and Brazil have the ability to expand capacity and increase exports if demand increases. The outlook for the next 10 years is favorable for the industry, but while Bioethanol may not be the silver bullet it is the "low-hanging-fruit" that helps countries accomplish GHG targets. Goals set at the Paris Climate Change Conference of 2015 revolved around climate change and how countries can mitigate GHG emissions. Bioethanol is proposed as a supplemental solution to this problem.

Bioethanol is shown to not only help mitigate emissions and decrease air pollution, but serve as a strong source for the development of coproducts. Capital for startup is high for Bioethanol processing facilities so policy must be sound and unwavering, not indecisive. Don't pull the rug out from those that invest in these projects or suddenly lower policy mandates. The Philippines is a great model of a country that developed a sound system for integrating Bioethanol. If the country can't produce enough quantity domestically to meet mandates, the difference is imported.

Trade has had a positive role in the development of the Bioethanol industry within the U.S., as new markets have helped producers remain economically viable. As the U.S. has witnessed, the mandate of E10 has had immediate benefits. The U.S. is sending a signal to the rest of the world that the country is willing to meet requirements by importing what it cannot sufficiently produce. The U.S. will look to increase the mandates in the future to possibly E15 and beyond, but education and progress within the industry must take place.

Presentation #2: "Status & Forecast of Bioethanol in Korea"

Presented By: Dr. Jin-Suk Lee, Korea Institute of Energy Research

Korea needs to address economic and environmental issues as well as envision a more sustainable economy that follows along with commitments made in mitigating GHGs. One of the biggest questions is how Bioethanol use will increase, as Dr. Lee envisions the biggest opportunities for implementation are within the transportation industries. Currently, Biodiesel consumption is high in Korea and nearly two times that of Bioethanol.

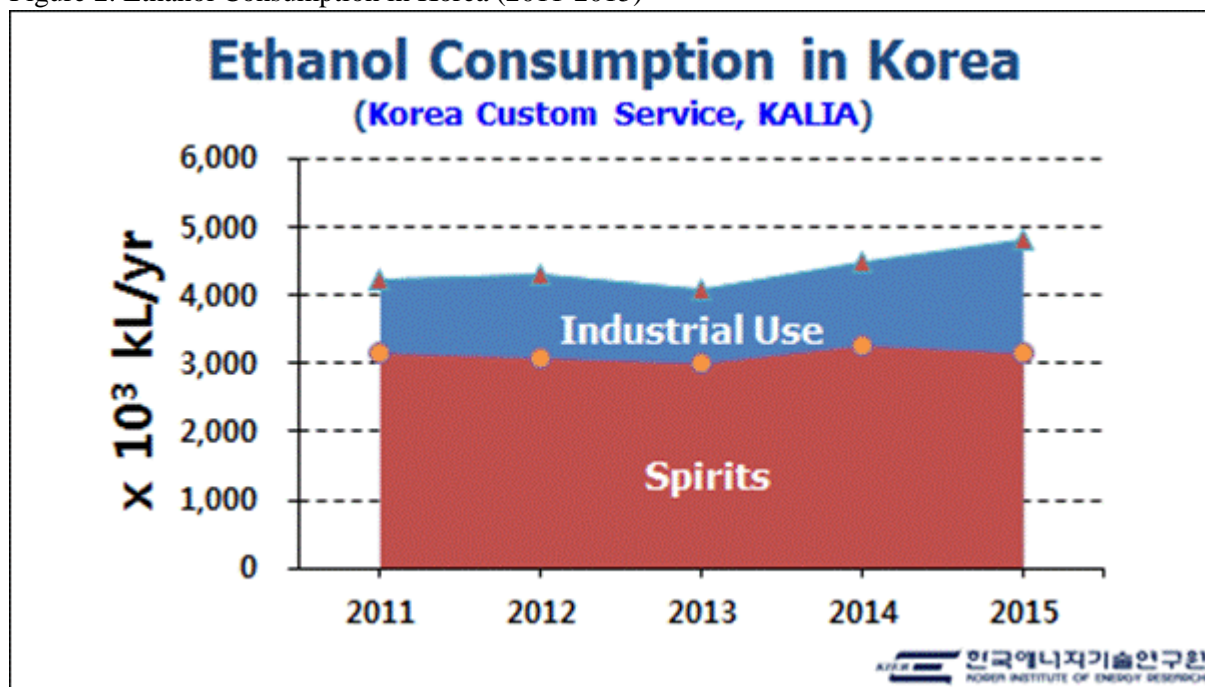
Biofuels in general require stimulus from the government, as Korea is attempting to develop a roadmap for implementation by conducting public hearings and establishing a RFS. There exists a gap between the targets set by the government for RFS and what may be viable for use. In Korea, the current mandate for Biodiesel is BD3 instead of the initially proposed idea of BD5, due in part to issues with sourcing (e.g. timing and reliability of raw materials for process) and energy security.

Reliability of supply continues to concern policy makers since domestic production of feedstocks is not sufficient, so supply issues with trade may occur. Korea has about 10 percent self-sufficiency for Bioethanol, so concerns exist about having to rely on foreign sources for supply. If Korea were to implement a RFS or a policy mandate, there is no turning back. Thus, management of the system could be difficult since domestic sources are scarce.

Concerns over phase-separation in ethanol blended with gasoline as well as water content in fuel storage are present, so tests were conducted by the KIER (Korea Institute of Energy Research) to assess feasibility. Small pilot tests were conducted with the implementation of Bioethanol but the project was small in scale, with the conclusion being no significant issues with distribution or usage. As such, the need for a larger scale project was apparent so an on-going project (2016-2018) with vehicle tests and distribution is underway to evaluate the general effects and feasibility of Bioethanol.

Concerns over the quantity imported for Bioethanol is encouraging policymakers and researchers in Korea to seek domestic sources of production. Current research pertaining to domestic feedstocks includes inedible cassava as well as overseas investments in palm oil to help meet potential RFS standards. What is vital to consider is the economic viability of these different sources, how well the technicalities can be solved, and finally how the public accepts edible grains being utilized for energy use. Due to the stigmatism regarding the use of edible grains, Korea is seeking out investments into inedible forms of biofuels.

Figure 2. Ethanol Consumption in Korea (2011-2015)



Source: Korea Institute of Energy Research (KIER)

Presentation #3: “Ethanol vs. Gasoline: Greenhouse Gas Emissions & Other Environmental/Health Benefits”

Presented By: Dr. Stephen Mueller, University of Chicago Energy Resources Center

Bioethanol processing creates various coproducts and different systematic flows, so it is pivotal to question whether ethanol is clearly a more sustainable system than gasoline. Processing of Bioethanol has shown to have environmental benefits but one must assess the entire system of each stage’s contribution, also known as the “Life Cycle Emissions Value.” By analyzing energy usage and emissions of the “Life Cycle Emission Value,” researchers can assess the sustainability of the system and analyze usage at every step of the supply chain.

With the utilization of tools such as the GREET MODEL, researchers are able to model various technologies in the life cycle. U.S. ethanol plants are on the leading edge of technologies that provide reductions in carbon-dioxide emissions through well-designed and efficient systems. For example, coproducts like corn oil can be processed into Biodiesel and carbon dioxide is recovered for food processing (e.g. carbonated beverages). Other coproducts include wet and dry DDGs, which are utilized as nutritious feed alternatives for livestock.

Analysis on land use of corn is important in assessing sustainability as well. New satellite based technologies (e.g. GRAS tool) helps researchers evaluate deforestation and whether the phenomenon has occurred in the development of farms. Thus, these tools can help verify sustainability claims. Utilization of Bioethanol is also the cheapest form of octane, especially when comparing to MBET (gasoline additive and source for increasing octane number) which has shown to have negative environmental effects.

Many steps in the life cycle process can sequester carbon, but one must assess emissions from both the transportation and production levels (farm-level to finished product). A combination of carbon sequestering technologies in corn ethanol can be more efficient than sugarcane used in Brazil due to the development of

coproducts. The process of assessing environmental benefits is a complex process, but with production of coproducts and technology improving, progress is apparent.

Figure 3. Ethanol Biorefinery Locations in the U.S.



Source : Renewable Fuels Association: Ethanol Biorefinery Locations

Presentation #4: “Ethanol Impacts /U.S. Bioethanol Policy and Market Experience”

Presented By: James Miller, Vice President / Chief Economist, Growth Energy

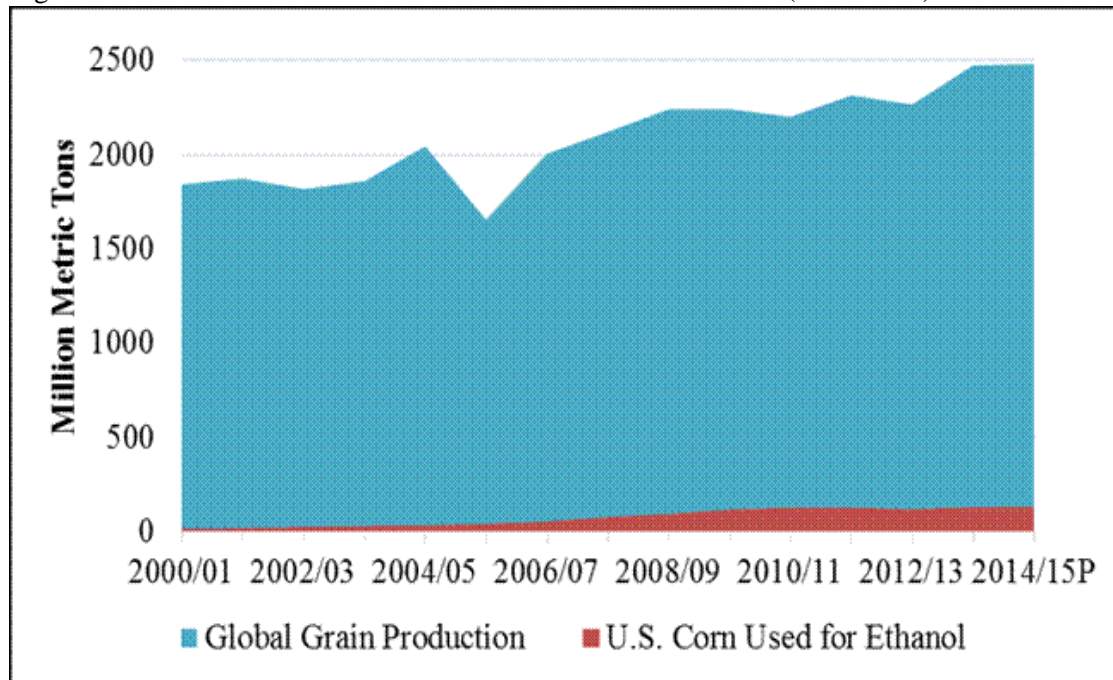
One of the concerns surrounding the use of ethanol is the impact on automobiles and whether certain negative outcomes arise from use. Mr. Miller states there have been no significant issues with the use of ethanol blends, as the fuel has been shown to reduce toxics (e.g. benzene, toluene, and xylene) in tailpipe emissions. Ethanol has engine benefits including increasing the compression ratio and engine efficiency. Engines of the future will be in demand of higher octane fuels, as ethanol’s octane properties (i.e. ethanol is a high octane fuel) can take advantage of these opportunities. With the effective ban of MTBE (i.e. potential human carcinogen), Bioethanol has become the oxygenate of choice that’s biodegradable and absent of MTBE’s detrimental effects.

Non-beverage production of ethanol has grown about five times that of early 21st century numbers as the U.S. is a net exporter. The U.S. must continue to strive for E25 or E30 as these optimize octane levels. Staying true to its commitment to meet mandates, the U.S. is also one of the biggest importers of ethanol. The U.S. is characterized as a free market without the use of subsidies (i.e. existed in the past) for domestic producers and the elimination of tariffs on imported ethanol, thus creating an environment for further progress into the fuel economy. There has also been the establishment of RINs (Renewable Identification Numbers), a compliance accounting mechanism for the EPA. RINs are attached to each gallon of renewable fuel and bought, sold, and traded among obligated parties. RIN market prices can incentivize increased blending and infrastructure development.

Policy challenges include the suspicion that the oil industry doesn’t want ethanol increasing its market share into

the future. The oil industry didn't hastily react to Bioethanol's gradual rise in the past. Now with market share approaching greater than 15 percent, the oil industry has stronger incentives to take notice. Though concerns exist over food security with increasing production of Biofuels, food is also heavily reliant on oil prices as well. Old data is used by competitors of Bioethanol to spotlight negatives upon the industry, which goes against the conventional wisdom of the research society. The U.S. sustains an efficient blend program with high quality standards that remains a model for interested countries to adopt. With the progress of coproducts and investments made in rural economies, Bioethanol's recent success has created positive multiplier effects that demands global recognition.

Figure 4. U.S. Corn Used for Ethanol of Global Grain Production (2000-2015)



Source: USDA/WASDE

Question & Answer Section

I. Questions for Michael Dwyer

- 1. Demand for Bioethanol is highly dependent on oil prices – do you have an analysis or forecast for oil prices and production into the future?**

The oil market is quite unpredictable with no clear cut answer as to what is going to happen. The U.S. has created a self-sufficient system and OPEC has lost control over production/pricing that it once had. We live in a period where many producers exist in the market that didn't in the past. If both oil and corn stay where they are in terms of price, Bioethanol is very affordable. Please don't consider oil as a substitute for ethanol. The global audience must consider ethanol's clear benefits to addressing air pollution issues and GHG mitigation.

- 2. Please go back to slide 10 or 11 that shows forecast of corn and sugar prices into the future. Will dramatic changes in these prices affect our import prices?**

Nobody can predict price, but there is evidence of stronger downward pressure on corn prices into the future.

When looking at these forecasted prices, please analyze the trend and don't look year-to-year. We are entering the 2nd generation for ethanol. Cellulosic ethanol is great for the future but we must consider the economies of scale with corn.

3. **3 countries (Korea, China and Japan) are developed but other developing countries across Asia are not able to sustain infrastructure of electric vehicles. Will electric cars grow in popularity and start to compete / replace markets that previously existed for Biofuels?**

You must think of how electricity is being sourced for the vehicles in terms of whether it is sustainable for the future, for example, China sources the majority of its electricity from coal power plants. There's no time in my lifetime to which electricity vehicles will be able to compete with the scale of gasoline/ethanol. Asia needs something other than just gasoline as you can see with the air pollution and citizens wearing masks. Need to capture air quality benefits of ethanol. Need to strive towards E10 here in Korea. Phase separation should not be an issue. The biggest issue is education.

4. **There has been a softening of refineries (ethanol) to distributors as far as quality, price, and producers in the market. What effect will this have in the future?**

There should be very little impact at the consumer level as I don't see it happening. No macro-benefits – need to create incentives (market-based) that can build infrastructure for ethanol.

5. **Korea imports because domestic production is not enough (biofuels). This relates to problems for an E-10 mandate. What is the outlook on importing corn and Korea using the raw material to process into its own fuel?**

No government research exists on differences between importing ethanol and importing corn for processing into fuel. The U.S. Grains Council conducted a study and found countries such as Korea and Japan were most feasible in importing corn and processing the fuel themselves. The country already buys 100% of foreign oil. Need to diversify fuel portfolio. There is one major benefit of considering the establishment of own processing facilities in Korea versus importing oil. Production of ethanol has many coproducts (e.g. DDGs) that could be beneficial but such a process demands a thorough knowledge of the production environment. If Korea were to do so, the country must consult with experts in ethanol production. Establishing the industry in Korea won't be financially viable if producers do not know how to successfully market and produce coproducts.

II. Questions for Jin-Suk Lee

1. **If Korea imports ethanol the country won't see full benefits of establishing a renewable fuels economy, so can we invest in overseas companies?**

Korea had the RFS Public Hearing in 2013 and there was much discussion concerning investment in production plants overseas with investments made in palm plantations/plants.

2. **Is there any value added to feedstock?**

Have to factor in currencies of different countries as far as price of imported biofuels and negotiation for implementation. Infrastructure is lacking for biofuels.

3. **In the case of rice, the Korean government used excess rice stocks for feed and Japan has been witnessed as doing the same. Do you see rice being allocated as a domestic source of Bioethanol in the future for security concerns? And what do you see as the most promising feedstock for Korea?**

We might need to use rice in the future for domestic production in biofuel, however the public will have to overcome the stigmatism that revolves around using this food staple as a fuel source. Korea must get the public to buy into the idea. The Korean government struggled with using rice as feed this year (2016), so potential as a fuel source is somewhat absent at this time. The most promising feedstock must factor production capacity and price so barley straw is one.

III. Questions for Steffen Mueller

1. **From the standpoint of Korea, how do you measure emissions from importing ethanol instead of just the carbon footprint with domestic use alone? How would you recognize reductions?**

Ocean vessels carrying the majority of product are highly efficient with very little carbon emissions. Europe has third party organizations that will independently assess situations for their own systems and help verify claims of whether sourcing foreign biofuels is indeed as sustainable as the research claims.

IV. Questions for Jim Miller

1. **How does Korea face challenges of shifting to Bioethanol from imported oil, as that has been one of the biggest stigmatism when thinking of going from a E-3 to E-5?**

The ethanol industry faces many challenges as the U.S. attempts to move to E-15 where a lot of problems are due to misinformation, for example, the oil industry using 20-year-old data against ethanol. The 2011 drought brought concern for both the livestock and ethanol sector, but we have overcome challenges during that time with the switch from E0 to E6. Now we are at E10 and want to get to E15. Though in its infancy, the industry has witnessed much progress. Examples are the alliances that have been made with the auto industry the initiative to move to a higher blend rate. The world is more concerned with global warming than in the past with the Paris conference proving this.

2. **I'm concerned with stability and security of supply. Supplies are up and down so production has reached a cap. Do you think corn is enough to make a big difference when switching from a 10 to 15 percent mandate? If more and more countries demand biofuels how will these factors affect food commodities?**

There will be an incentive to increase production capacity with true market forces. This will affect the overall strategy of biofuels but the capacity is there to meet demand from around the world. Cellulosic is important to keep in mind but does not nearly match the capacity at which corn starch is able to meet demand, but I can see the cost of cellulosic going down soon.

3. **We see this trend of increasing the mandate, so what other grains can be involved in the process without all the reliance on corn?**

Sorghum and other winter crops as well as cellulosic (including waste and forest products) are promising. Use of a winter cover crop can help better manage the soil and fixate nitrogen into the soil while farmers transition through seasons, and these cover crops can then be used for fuel. Then we also have the cellulosic material left from the cover crop. Talk about efficiency and sustainability. Many of these crops can be stored unlike sugar.

